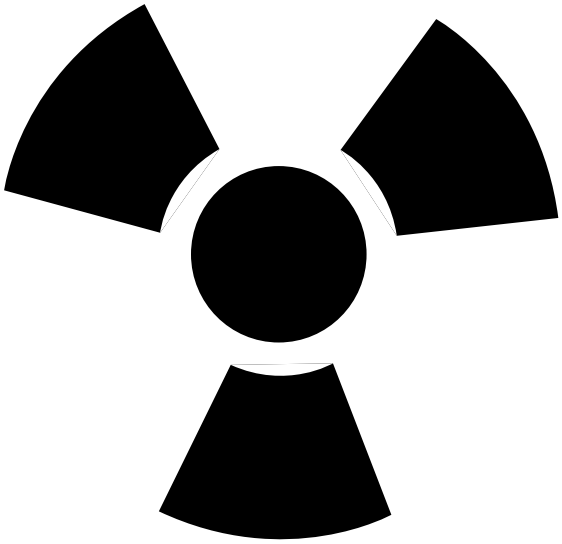
# RADIOLOGICAL SAFETY MANUAL



## National Cancer Institute at Frederick

**Frederick, Maryland 21702**

**Revised 2003**

# RADIOLOGICAL SAFETY MANUAL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# FOREWORD

The use of radioactive materials and devices that produce ionizing radiation is necessary to conduct research at the NCI-Frederick Cancer Research and Development Center. This manual presents general guidance on the necessary precautions and regulations for the safe handling of such sources.

The use of radioactive materials at the Facility is controlled by the regulations of, and a license issued by, the U.S. Nuclear Regulatory Commission. The contents of this manual are an integral part of that license and, as such, are enforceable by the Commission.

To ensure that radiation sources are being used safely and in a manner that complies with all applicable regulations, a Radiation Safety Committee and a Radiation Safety Office operate at the Facility. This manual sets forth the responsibilities of that Committee and of the Radiation Safety Office. It also details the responsibilities of persons who handle radiation sources as well as the necessary requirements for the safe use of such materials.

All persons working with sources of ionizing radiation at the Facility must be familiar with the contents of this manual and shall abide by the procedures and policies herein established.

This manual is a preliminary introduction to basic requirements for radiation safety in the laboratory. It is the responsibility of every user to seek out specific training and instruction for procedures employed in their laboratory from their supervisor, other trained workers, or the Radiation Safety Office.

Date_____ _____

Marjorie C. Strobel. Ph.D.
Scientific Operations Manager, OD

Date_____ _____

Larry O. Arthur, Ph.D.
Principal Investigator, OTS, SAIC-Frederick

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I. Administrative Control

A. Radiation Safety Committee

1. General

The NCI-Frederick Cancer Research and Development Center (FCRDC) Radiation Safety Committee was established by the Director, Frederick Operations, Science Applications International Corporation, to ensure that all sources of ionizing radiation at the FCRDC are used safely and in a manner that complies with all applicable regulations. The Radiation Safety Committee reports to the Director, Frederick Operations, Science Applications International Corporation and directs the operation of the Radiation Protection Office.

2. Committee Responsibilities

a. Act for the Director, Frederick Operations, Science Applications International Corporation as the authoritative body on radiological safety.

b. Review and approve or disapprove all proposed uses of ionizing radiation sources at the FCRDC.

c. Establish policy regarding the safe use of ionizing radiation sources.

d. Assure that applicable regulations and FCRDC policies are being met by users of radiation sources.

e. Ensure that all investigators who use ionizing radiation sources are qualified by experience or training to use such sources.

f. Provide technical supervision of the Radiation Protection Office.

g. Review all instances of alleged infractions of regulations or policies and recommend appropriate corrective action.

h. Suspend any project or procedure that it finds to be a threat to health or property.

I. In the process of reviewing proposed uses of ionizing radiation, the

Committee makes no judgement as to the scientific merit of such use. The Committee is concerned only with health and safety.

3. Committee Membership and Meetings

   a. The Committee shall consist of at least ten members. Potential Committee members will be nominated to represent the administrative area in which a vacancy exists and appointed by the Director, Frederick Operations, Science Applications International Corporation.

   b. The Radiation Protection Officer is an ex-officio member of the Radiation Safety Committee.

   c. The Radiation Safety Committee shall meet in formal session at least twice per year. The Committee shall maintain complete records of its activities.

B. Radiation Protection Officer

1. General

   The Radiation Protection Officer functions under the technical direction of the Radiation Safety Committee. The Radiation Protection Officer is the operational agent of the Radiation Safety Committee.

2. Functions and Responsibilities

   a. Formulates and operates a radiological protection program that ensures that the uses of ionizing radiation sources at FCRDC are in compliance with all applicable regulations.

   b. Performs and supervises a surveillance program to ensure that all operations at FCRDC involving ionizing radiation are in compliance with applicable regulations and FCRDC procedures and policies.

   c. Provides periodic reports to the Radiation Safety Committee on the status of the radiological protection program and the surveillance activities.

   d. Approves or disapproves the procurement, shipment, and distribution of all radioactive materials to or from the FCRDC.

   e. Receives and inspects all shipments of radioactive materials being

delivered to the FCRDC.

f. Approves and signs or disapproves all correspondence to the U.S. Nuclear Regulatory Commission (NRC).

g. Provides disposal services with coordination with U.S. Army Garrison Radiation Protection Officer.

3. Authority

a. The Radiation Protection Officer may enter any laboratory or area where ionizing radiation sources are, or might be, used or stored. This includes areas that might be contaminated.

b. The Radiation Protection Officer may suspend, pending Radiation Safety Committee review, any project or procedure that is in violation of NRC regulations, NCI-FCRDC policies and requirements, or which is believed to be a potential threat to health or property.

c. The Radiation Protection Officer may take immediate possession or establish control over any source of ionizing radiation that is possibly being used or stored in an unsafe manner. Such action is subject to Radiation Safety Committee review.

C. Principal Investigator

1. Definition

A Principal Investigator is a person who is directly responsible for the specific project under an approved Radiological Program issued in writing by the FCRDC Radiation Safety Committee. The Principal Investigator has complete authority over all personnel in his/her program regardless of company affiliation or supervisory status.

2. Responsibilities

a. The Principal Investigator is personally responsible for the use of ionizing radiation sources possessed under the authority of the Principal Investigator's Radiological Program.

b. The Principal Investigator must ensure that all FCRDC policies, procedures, and regulations are being met. This includes worker supervision and training, maintaining required records (see Appendix I), and performance of all required tests.

c. The Principal Investigator must provide the Radiation Protection Officer with all the information and data requested by the Radiation Protection Officer or the Radiation Safety Committee.

d. The Principal Investigator must ensure that all persons using radioactive materials under the Principal Investigator's Radiological Program are using the materials safely and that they are kept informed concerning new techniques, procedures, and sources.

e. The Principal Investigator must prepare and submit to the Radiation Protection Officer any changes in personnel or procedures as an amendment to the Radiological Program.

f. The Principal Investigator may propose (for Radiation Protection Officer approval) that a Radiation Area Supervisor be appointed, who will assist him in the performance of the above mentioned responsibilities.

D. Radiation Worker

1. Definition

A Radiation Worker is a person who voluntarily performs work involving sources of ionizing radiation. Such a person shall know that the work involves the use of ionizing radiation before the work commences. A Radiation Worker works under the supervision of the Principal Investigator or Radiation Area Supervisor regardless of company affiliation or supervisory status.

2. Responsibilities

a. Each radiation worker shall have ready access to a copy of this manual and shall be familiar with the requirements specified in the manual.

b. A Radiation Worker shall <u>not</u> use sources of ionizing radiation in a manner that violates NRC Regulations, FCRDC policies or

procedures, or the conditions specified in the Radiological Program issued by the Radiation Safety Committee.

c. A Radiation Worker shall take all necessary actions that will maintain radiation exposures as low as possible.

d. A Radiation Worker shall seek the assistance of the Principal Investigator or the Radiation Protection Officer whenever there is any doubt or uncertainty about a procedure or policy concerning sources of ionizing radiation.

e. A Radiation Worker will immediately report any accident or unusual occurrence involving ionizing radiation sources. This report should be made to the Principal Investigator or the Radiation Protection Officer.

f. A Radiation Worker shall not purposefully defeat, disengage, or deactivate any device designed to provide a safe environment with sources of ionizing radiation.

g. A Radiation Worker shall comply with all approved radiological safety procedures.

h. A Radiation Worker shall report to the Principal Investigator or the Radiation Safety Committee all uses of radiation sources that are not in accordance with applicable regulations, policies, procedures, or conditions of the Radiological Program.

## II. Administrative Procedures

### A. General

In all operations involving sources of ionizing radiation (radioisotopes, X-ray machines, electron microscopes, accelerators, static eliminators, etc.) the written approval of the FCRDC Radiation Safety Committee must be obtained prior to the procurement, receipt, installation, operation, or use of a radiation source. There are no exceptions to this policy. A program or project using approved sources of ionizing radiation is hereafter referred to as a Radiological Program.

### B. Application Procedure for a Radiological Program

1. An application for an approved Radiological Program is prepared by the Principal Investigator. It is suggested that the Radiation Protection Officer be consulted for comments and suggestions concerning the

application prior to the final preparation of the document.

2. The application is submitted in duplicate to the Radiation Safety Committee through the Radiation Protection Officer.

3. The form of the application and directions for its completion are included in Appendix II.1 of this manual.

4. Any change in isotope usage not covered in the original program document must be approved prior to initiation. This includes changes in isotopes, increases in activity levels, and substantial changes in protocol design.

5. Except as provided in Part 19 of the NRC Regulations (10CFR19), all correspondence to the NRC concerning the use of radioactive materials at the FCRDC must be forwarded through the Radiation Protection Officer.

C. Facility Inspection

Prior to Radiation Safety Committee review of an application, the Radiation Protection Officer will conduct an inspection to ensure that the facilities and equipment to be used are adequate for the safe use of the radiation sources listed in the application. This inspection may involve a check on ventilation systems, filters, hoods, survey instruments, waste storage techniques, flooring, bench surfaces, shielding, security, handling tools, and safety equipment. The Radiation Protection Officer must approve the equipment and facilities prior to Radiation Safety Committee review and approval of the proposed Radiological Program.

D. Training

Principal investigators and radiation workers must have received training and experience in the use of radioactive materials. The training and experience will be evaluated by the Radiation Safety Committee relative to the isotopes and possession limits requested in the application for a Radiological Program. The Radiation Protection Officer provides courses in radiation safety and informal instruction dealing with safety techniques, procedures, and requirements of the NCI-FCRDC.

Specific safety procedures for each protocol carried out in a Radiological Program are the responsibility of the Principal Investigator, and should be

thoroughly reviewed with each new radiation worker, regardless of prior background.

Documentation of the above training must be maintained in the program file.

The Radiation Protection Officer is available to assist in the development of safety procedures, as needed.

E. Procurement of Radioactive Materials (see also Appendix II.2)

1. All requests for the purchase of ionizing radiation sources must be approved by the Radiation Protection Officer.

2. All deliveries of radioactive materials must be made directly to the Radiation Protection Officer unless prior arrangements have been made with the Radiation Protection Officer for delivery elsewhere.

F. Inventory and Shipment (see also Appendix II.3)

1. Each Radiological Program must maintain a current inventory of radioactive materials. These records must show:

   a. The receipt of all packages listing the radioisotope, chemical form, and activity

   b. The use and disposal of all radioactive materials

   c. The transfer or shipment of radioactive materials

2. The Radiation Protection Officer must be notified prior to all transfers of radioactive materials to other programs within the FCRDC or to anywhere outside of the FCRDC.

G. Disciplinary Action

1. The Radiation Safety Committee has the authority to terminate any Radiological Program if the Principal Investigator or anyone under the Principal Investigator's supervision fails to comply with NRC Regulations, FCRDC policies and procedures, and/or conditions specified in the approved Radiological Program.

   The Radiation Protection Officer or the Radiation Safety Committee Chairman, can temporarily suspend any worker or program, based on

the above, subject to review by the Radiation Safety Committee.

2. The Radiation Safety Committee may alter an approved Radiological Program in order to maintain the program in compliance with applicable regulations or policies.

3. The Radiation Safety Committee will provide a means of appeal to the Director, Frederick Operations, Science Applications International Corporation for any Principal Investigator who does not agree with decisions of the Radiation Safety Committee.

H. Termination or Change of a Radiation Program (see also Appendix II.4)

1. Whenever a Radiological Program is to be terminated or an area is to be returned to non-radiological uses, the Radiation Protection Officer must be notified.

2. A Radiological Program is not terminated until the Radiation Protection Officer determines that:

a. All sources and contamination have been removed.

b. All warning signs have been removed.

c. The responsibility for existing radioactive sources has been properly transferred.

d. All required records and other radiation protection matters have been completed and reviewed.

e. A written statement has been received by the Principal Investigator from the Radiation Protection Officer, confirming that the Radiological Program has been terminated.

I. Amendment of Radiological Program

1. Any amendment to a Radiological Program must be submitted as a written request from the Principal Investigator to the Radiation Safety Committee through the Radiation Protection Officer. (See also I C2e page 3.)

III. Rules for the Use of Radiation Sources*

* A summary of the rules is available in English, French, Spanish, German, Italian, Japanese, and Chinese and may be obtained from Radiation Safety upon request.

A. General

1. The primary ingredients in the safe handling of radiation sources are:

    a. Designing the experiment to use minimal quantities of radiation

    b. Maximizing distance between source and worker

    c. Minimizing exposure time

    d. Utilizing shielding

    e. Using radioactive materials in closed systems or well ventilated areas or hoods

    f. Planning to contain and limit the spread of contamination

2. Eating, smoking, drinking, and food storage are not permitted in any area where radioactive materials are used or stored.

3. Mouth pipetting of liquids containing radioactive materials is not permitted under any circumstances.

4. Protective gloves must be worn whenever radioactive materials are handled.

5. Work surfaces, trays, etc. shall be covered with plastic-backed absorbent paper (plastic side down) whenever radioactive materials are used or stored.

6. Whenever possible, remote handling equipment, such as tongs, forceps, clamps, mechanical arms, etc., should be used to handle radioactive materials that produce high exposure rates.

B. Hoods, Laminar Flow Cabinets, and Biological Safety Cabinets

1. A fume or biological hood will be used in all radiological operations during which there is a chance that airborne radioactive materials will be produced.

2. The type of hood, airflow requirements, and filtration requirements will be determined by the Radiation Protection Officer.

3. Laminar flow cabinets with 100% air recirculation may be used for work

involving nonvolatile radioactive materials. The level of activity may not exceed 100 microcuries. Radioiodine is not to be used in any activity levels in air recirculation hoods.

C. Shielding and Work Surfaces

1. The Radiation Protection Officer should be consulted when sources are to be used that would produce significant exposure rates if they were not shielded. Shielding will be necessary when sources that emit high energy beta particles are used.

2. All work surfaces where radioactive materials are to be used will be constructed with materials that are nonporous and resistant to attack by solutions used in the experimental procedure. The surfaces must be void of open seams and easy to clean.

3. Floors in areas where radioactive materials are to be used may not consist of bare concrete or other porous material. The Radiation Protection Officer should be consulted concerning adequate floor coverings.

D. Surveys and Monitoring

1. Tests for contamination on working surfaces, floors, hoods, etc., shall be performed by the user whenever radioactive materials are used or whenever there is a reason to suspect contamination. The tests are normally performed by wiping a surface of known area with Parafilm M and then determining the activity on the film. The results are to be expressed in activity units per unit area ($\mu$Ci/100 $cm^2$). Records shall be kept on both positive and negative results. Records kept in terms of "counts" are not satisfactory.

2. Radioisotope laboratories will be equipped with radiation monitors and/or survey instruments suitable to detect the type of radioactive materials used in the laboratory. The type and number of such instruments will be determined by the Radiation Protection Officer.

E. Protective Devices and Clothing

1. Laboratory clothing will be worn in all areas where radioactive materials are used.

2. If laboratory clothing becomes contaminated, it should be placed in a plastic bag. The Radiation Protection Officer should be notified and the clothing biologically decontaminated if necessary.

3. Personnel working in areas where airborne radioactive materials are present may be required to wear protective respiratory equipment. The Radiation Protection Officer will specify what type of respirator or mask is necessary.

F. Maximum Permissible Exposure Rates

1. Definitions

a. Unrestricted Area means any area in which non-radiation workers can or may be found. The maximum permissible exposure rate anywhere in an unrestricted area is 0.25 millirem per hour. All reasonable efforts should be made to keep exposure rates in unrestricted areas below this limit.

b. Restricted Area is an area in which only radiation workers are allowed. The maximum permissible exposure rate anywhere in a restricted area is such that no individual will receive in a calendar quarter a dose in excess of:

(1) 1.25 rems to the whole body, head and trunk, active blood-forming organs, or gonads

(2) 3.75 rems to lens of the eye

(3) 12.5 rems to extremities

(4) 12.5 rems to the skin of the whole body

c. A Radiation Area is any area accessible to personnel in which the radiation dose rate is such that a major portion of the body could receive in excess of 5 millirems in one hour.

d. A High Radiation Area is any area accessible to personnel in which the radiation dose rate is such that a major portion of the body could receive a dose in excess of 100 millirems per hour.

e. An Airborne Radiation Area is any area in which the airborne radioactivity exceeds the limits prescribed in Appendix B, 10CFR20, or where concentrations, averaged over the number of hours in any week during which individuals are present in the area, exceed 25 percent of the limits specified in Appendix B, 10CFR20, of the NRC Regulations.

2. Occupational Exposure of Fertile Women

During the entire gestation period, the maximum permissible dose equivalent to the fetus from occupational exposure of the declared pregnant female may not exceed 0.5 rem. The pregnancy declaration should be made to Occupational Health Services staff at the earliest indication of pregnancy.

G. Posting Requirements

1. All areas where radioactive materials are used or stored shall be conspicuously posted with a standard "Caution-Radioactive Materials" sign. See Appendix III.

2. All radiation areas shall also have a sign posted that reads "Caution-Radiation Area." See Appendix III.

3. All high radiation areas shall also have a standard radiation warning sign posted that reads "Caution-High Radiation Area."

4. All airborne radiation areas shall also have a standard radiation warning sign that states "Caution-Airborne Radiation Area."

5. All areas where radioactive materials are used shall have posted a Form NRC-3 and a notice indicating the location for inspection of the following:

a. NRC Regulations

b. NRC License

c. All correspondence relating to the License

6. Radiation caution signs or labels will be attached to all fume hoods, containers, and other equipment that contain or are contaminated with radioactive materials. These signs will have the following information printed on them:

a. The radiation caution symbol

b. The words "Caution-Radioactive Materials"

7. At the discretion of the Radiation Protection Officer, additional items such as barricades, ropes, and painted warning lines may be required.

8. All sealed sources in excess of ten times the activities specified in Appendix C, 10CFR20, of the NRC Regulations or the containers in which they are stored will be marked with a sign or tag containing the following information:

a. The name of the isotope

b. The dose rate at the surface of the container

c. The activity of the source

d. The name of the person responsible for the source

9. The Radiation Protection Officer should be contacted for assistance in labeling shipments. The Radiation Protection Officer will supply upon request signs and tags that can be used.

H. Radioisotope Storage and Security

1. Operational Policy

a. Unless under direct and immediate observation, storage units containing radioactive materials shall REMAIN locked during working hours. This applies to refrigerators/freezers containing stock isotopes as well as waste containers. Otherwise, the room or area must be secured.

b. All waste receptacles and storage units (e.g., freezer), which contain radioisotopes and cannot be secured, shall be located in areas where access can be controlled (e.g. lab rooms, equipment rooms, anterooms).

c. Untended lab rooms containing unsecured radioactive material must be locked even during daytime hours. This would apply to lunch breaks, for example, but not to going between neighboring labs briefly to carry out on going procedures.

d. The above regulations shall be enforced at the lab and/or

program level, regardless of the security status of the building.

Violations of this policy will be considered on an equal basis with violations of other manual requirements when auditing or reviewing programs for compliance.

I. Waste Disposal

1. Containers for liquid or solid radioactive waste are available from the Waste Management Office. Radioactive wastes will be picked up by the Waste Management Office.

2. Radiological wastes consisting of short-lived nuclides may be held for decay if the Radiation Protection Officer approves of the specific procedures.

3. Radiological waste from biologically contaminated areas must be properly sterilized before removal to a clean area by the user.

4. Solid wastes should not be placed in liquid waste containers. The activity and the identity of the isotope placed in waste containers must be recorded, dated, and initialed.

5. Animal carcasses or animal parts containing radioactive materials will be disposed of by the Waste Management Office. These waste materials shall be sealed in polyethylene bags and kept frozen until they are picked up by the Waste Management Office.

6. No liquid radioactive wastes will be discarded into a sink or drain in any facility of the FCRDC.

7. The Radiation Protection Officer will ensure that all waste materials are disposed of in accordance with NRC Regulations.

J. Special Procedures for Radioactive Iodine

1. Radiation Workers performing Iodinations will be required to obtain a thyroid scan within 72 hours of the procedure (but waiting at least 6 hours for distribution of a major part of the iodine to the thyroid). A Baseline Scan shall be performed on new users prior to beginning work with radioactive iodine.
2. The iodine concentrations in the breathing zone air of the user and in the exhaust air from the hood will be measured whenever an iodination procedure is performed. The concentrations are determined by passing

a known air volume through activated- charcoal-filled tubes. The Radiation Protection Officer will be responsible for collection of the tubes and their assay. The following information will be provided to the Radiation Protection Officer with each sampling tube:

a. The rate at which air was drawn through the tube in liters per minute

b. The sampling time interval

c. The iodine isotope used in the experiment

d. The date of the procedure

e. The name(s) of the employee(s) performing the iodination

K. Special Procedures for Radioactive Phosphate

Any use of 10 mCi in a single container must utilize lucite or lead shielding or remote handling equipment (forceps) for the stock container. Contact the Radiation Protection Officer for additional information on other shielding requirements.

L. Radiation Alarms and Entry Control Systems

1. All high radiation areas and airborne radiation areas will be equipped with devices that prevent unauthorized entry.

2. All high radiation areas will be equipped with a device that will either:

a. Cause the radiation levels to fall below 100 millirads per hour upon entry into the area or

b. Energize a visible or audible alarm signal that will warn the person entering the area and the operational personnel about the unauthorized entry

M. Equipment Decontamination

1. The Radiation Protection Officer should be contacted for assistance in all radiological decontamination procedures.

2. The easiest way to solve the problem of equipment contamination is to use procedures that prevent the contamination initially. Sometimes equipment can be protected with plastic or other types of containment

that will prevent contamination.

3. If biological materials are involved, the biological decontamination or sterilization must be considered and performed before radiological decontamination. Biological treatment consists of placing the equipment in nonporous containers and then either autoclaving, treating with ethylene oxide, or by other methods approved by Biological Safety.

4. The maximum permissible contamination levels for alpha and beta-gamma radiation are 10 and 500 disintegrations per minute, respectively, for an area of 100 $cm^2$. These limits are for removable contamination. If the contamination is not removable, then the limits are 300 dis/min/100 $cm^2$ for alpha activity and 0.1 millirem/hr for beta-gamma radiation.

5. The individual responsible for the contamination will be expected to do most of the cleanup under the supervision of the Radiation Protection Office staff.

N. Personnel Decontamination

1. The most important aspect of personnel decontamination is speed. First, all contaminated clothing must be removed and the body monitored to locate contaminated areas. If the contaminated area is small, then the decontamination can be performed in the laboratory. If large areas are contaminated, then the person involved should be dressed in expendable clothing and taken to the showers.

2. Affected areas must be washed with soap and water. Use of a brush or abrasives is not advised. Affected areas should be dried and monitored again for contamination. This procedure should be repeated no more than four times. If contamination persists, the physician at Occupational Health Services, extension 1096, should be contacted.

3. Prolonged use of any one method of decontamination should be avoided because skin irritation might result, which could lead to the absorption of radioactive material into the body through breaks in the skin. Organic solvents should not be used.

O. Leak Testing Sealed Sources

Sealed sources containing beta and/or gamma emitting radioactive materials must be tested for leakage every six months. Sealed sources that contain alpha emitting radionuclides must be tested for leakage every three months. These tests will be performed on all sealed sources having activities in

excess of 100 microcuries. These tests will be performed by the Radiation Safety Office.

P. Transfer, Shipment, and Storage of Radioactive Materials (see also Appendix II.3)

1. The Radiation Protection Officer must be contacted prior to the transfer of radioactive materials from one program or building to another within the FCRDC.

2. All packaging of shipments of radioactive materials to locations not within the limits of the FCRDC will be performed by the Radiation Protection Officer. (Packaging shall be in compliance with Titles 10 and 49 of the Code of Federal Regulations.)

3. All radioactive materials sent to the FCRDC are delivered to the Radiation Protection Officer (Building 426). The Radiation Protection Officer will open the package, inspect for damage, and test for excessive exposure rates and contamination in keeping with provisions expressed in 10CFR20.1906. Packages passing the inspection will then be delivered to the user who ordered the material.

4. Each program using radioactive materials must have adequate facilities for the storage of the materials being ordered.

Q. Personnel Monitoring and Bioassays

1. Radiation Workers who are authorized to manipulate radioisotopes that emit high-energy betas, gamma rays, or x-rays will be issued Dosimetry Device(s). These devices (film badges, TLDs, etc.) are designed to measure one's radiation exposure. The RSO, with the approval of the Radiation Safety Committee, may permit exceptions or may initiate additional requirements to this policy.

2. All Radiation Workers who perform Iodinations must meet the special bioassay requirements (See Section III-J, page 13, or this manual).

3. Radiation Workers who manipulate 10 mCi or more in a single experiment are required to submit a urine specimen to the Radiation Safety Office. The Radiation Safety Office must process these "High-Activity Urine Bioassays" within a 72-hour timeframe. It is the responsibility of the Radiation Worker to notify the Radiation Safety Office that specimens are ready for assay.

R. ALARA Program Statement

1. Policy Statement

The management of Science Applications International Corporation in keeping with the intent of new Part 20, recognizes its responsibility to keep exposures from radiation sources as low as reasonably achievable (ALARA) for employees, visitors, and students and to avoid significant increases in environmental radioactivity.

To accomplish this goal, management will provide information and policy statements to research personnel regarding its commitment to this end.

Management's program to achieve ALARA will include periodic audits of its radiation program, continued evaluation of Radiation Safety staffing and program requirements, and the presentation of programs which enhance the training and continuing education of personnel involved in the use of radioactive material. Management will also delegate sufficient authority to the Radiation Safety Office, through the Radiation Safety Committee, to enforce the policies which define the ALARA program.

2. Specific ALARA Program Criteria

a. Goals Relating to Exposure Control

Science Applications International Corporation will endeavor to maintain exposure doses equal to or less than 5% of authorized limits. Any values in excess of this goal will be investigated to determine the cause. Suggestions to alter protocols and/or procedures to achieve the 5% goal will be made.

b. Monitoring

10 CFR lists specific monitoring requirements for both external radiation exposure [20.1502(a) and 20.1502(a)(3)] and internal radiation exposure [20.1502(b)]. However, Science Applications International Corporation intends to continue to monitor each individual using isotopes other than tritium, carbon-14 and sulfur-35 with personal film and/or TLD dosimeters. This monitoring proposal will exceed the described requirements of 10 CFR for external monitoring.

Bioassays and air sampling will be used to evaluate potential

internal and airborne concentrations of isotopes, respectively. These values will in turn be used to compute the committed effective dose equivalent (CEDE) as required.

Records of all monitoring procedures and associated exposure values will be kept as part of each individual's exposure history. NRC Form 5 (6-92) or an equivalent will be used for the recordkeeping.

A review of results from our present monitoring program for the past twenty years shows that exposure values in excess of limits specified in Table 1 of regulatory guide 8.34 are not likely. In fact, an estimation of a possible occupational dose for an individual at our facility would be below 100 mRem (1 mSv) total per year. For a majority of the individuals there would be zero exposure as has been shown in the yearly statistical reports from our film badge supplier.

IV. Accidents Involving Radiation

A. Radioactive Material Spill

1. The following general procedures shall be followed when a radioactive material is spilled.

   a. Provide necessary emergency first aid to all serious injuries.

   b. Evacuate all personnel to an area removed from the effects of the spill and close all entrances to the spill area.

   c. If airborne radioactive materials are suspected, close all doors. Turn off laminar flow hoods that do not exhaust to the outside.

   d. Call the Radiation Protection Officer on extension 1451.

   e. Keep all persons known or suspected of being contaminated confined to one area to prevent the further spread of contamination. Do not allow other persons to enter this area.

2. The Radiation Protection Officer will immediately dispatch personnel and necessary equipment to the scene of the incident and shall perform the following upon arrival at the scene:

   a. Ascertain that all personnel have been evacuated from the hazard area, ensure that entry into the area has been restricted, and

ensure that all serious injuries have received medical attention.

b. Monitor all personnel involved in the incident to determine the extent of the contamination. The Radiation Protection Officer will initiate necessary personnel decontamination procedures. The Principal Investigator or other knowledgeable person may monitor immediately if deemed essential.

c. Evaluate the hazard area.

d. Supervise the decontamination of the contaminated area.

e. Investigate the cause of the incident and report to the Radiation Safety Committee on the cause as well as actions taken to prevent such an incident in the future.

B. Fires or Explosions Involving Radioisotopes

1. When a fire or explosion occurs involving radioisotopes, the Radiation Protection Officer will be notified immediately and the proper damage control office will be called.

2. All damage control equipment and personnel will be monitored by the Radiation Protection Officer for contamination before being permitted to leave the area. The only exception to this policy is in the event that personnel are seriously injured. The medical personnel involved will be informed that the person is or might be contaminated.

3. All damage control personnel will be equipped with dosimeters and respiratory protective devices when entering such an area. This policy shall not prevent entry in order to perform a life-saving rescue.

4. The Fire Department will:

a. Maintain familiarity with the location of all high radiation areas, airborne radiation areas, and radiation areas.

b. Train personnel to recognize the different radiation caution signs and understand the meanings of such signs.

c. Notify the Radiation Protection Officer whenever a fire involves

radioisotopes.

d. Wear dosimetric and respiratory equipment when responding to an incident where radioactive materials are used.

5. The Protective Services personnel will:

a. Notify the Radiation Protection Officer of any radiation accident during off-duty hours.

b. Be thoroughly familiar with the radiation caution signs and the meanings of such signs.

6. The Occupational Health Services Department will:

a. Ensure that personnel know and understand the radiation caution signs.

b. Observe the precautions and procedures prescribed by the physician in handling patients who are or may be contaminated with radioactive materials.

c. Wear the necessary dosimetric and protective equipment as instructed by the Radiation Protection Officer and the physician.

7. The Radiation Protection Officer will:

a. Inform the Fire Department about the location of all high radiation areas, airborne radiation areas, and radiation areas.

b. Furnish dosimetric and protective equipment to damage control and security personnel as required.

c. Keep Protective Services up to date with respect to telephone numbers and the names of personnel to be contacted when a fire or explosion occurs during off-duty hours.

d. Prepare all reports that may be required by the NRC Regulations.

# APPENDIX I

## SUMMARY OF REQUIRED RECORDS

The following is a list of records that are required. The Principal Investigator and Radiation Protection Officer are jointly responsible for the maintenance of these records.

1. Receipt, use and disposal of radioactive materials.

2. Transfer or shipment of radioactive materials records.

3. Contamination test results.

4. Laboratory monitoring tests.

5. Records indicating the instruction of radiation workers in proper experimental procedures.

6. Personnel monitoring and bioassay results.

7. Sealed source leak test results.

8. Records of tests on alarms or entry control devices.

9. A copy of the current Radiological Program and all applications for that program.

# APPENDIX II

## RADIOLOGICAL PROGRAMS AND PROCUREMENT OF RADIOISOTOPES

1. RADIOLOGICAL PROGRAMS

   a. Radioisotopes

      (1) All operations involving the use of radioisotopes at FCRDC must have an approved Radiological Program. Approval must be received prior to the beginning of any radiological operation or the procurement of radioisotopes and other sources of ionizing radiation. The program shall be submitted for approval to the FCRDC Radiation Safety Committee, through the Radiation Protection Officer, in duplicate and will include the following information:

         (a) The project wishing to use or procure radioisotopes

         (b) The full names, including middle names, social security numbers, and birth dates of the Radiation Area Supervisor and all operational personnel, as well as a "Resume of Experience of Radiation Personnel" for each person (see form for training and experience, page 27)

         (c) The radioisotope, its chemical and physical forms, and the amount of activity (e.g., μCi/ml) to be used during the experiment as well as the total amount of activity (inventory) of each isotope to be maintained under the program

         (d) A complete description of the proposed radiological operations to be performed

         (e) An outline of the protocol specific training to be presented applicable to the proposed radiological operations. Also describe the method of documenting that such training was presented.

         (f) The location by building and room number or area in which the radiological operations are to be performed

         (g) A complete list of radiation monitoring and other equipment available for the proposed program, including protective equipment available in the radiation area

         (h) The radiation safety precautions to be used

(I) A description of proposed waste storage space and handling methods

(J) The signature of the Supervisor or Principal Investigator in charge of the activity

(2) The radiological program will be approved on the basis of the SOP and the available equipment and facilities, as well as the radiation experience of the operating personnel and the responsible investigator.

(3) The FCRDC Radiation Safety Committee will certify approval and assign a number to the proposed program through the Radiation Protection Officer. Radiological operations shall not begin until the proposed program has been returned to the requestor with an endorsement granting approval for the program.

# Application for NCI-FCRDC Radiological Program

**Program Summary**

**Principal Investigator:**

**Organization:**

**Location:**

**/__/ NEW PROGRAM APPLICATION  /__/ PROGRAM RENEWAL**

**Program Type:**

**/__/ ISOTOPE  /__/ X-RAY**

**/__/ EM  /__/ OTHER**

**P.I.:**
**Degrees**
**Primary Radiologic Training:**

**Radiation Area Supervisor:**
**Degrees**
**Primary Radiologic Training:**

**Facilities:**
**Rooms**

**Hoods**

**Detection Devices**

**Storage areas: (specify liquid and dry)**

**Isotopes/Maximum Inventory/Per experiment Use:**

**Complete Program Application Attached:**
**---**
**APPROVALS:**

**Organization Director:_____ Date:_____**

**Radiation Protection Officer:_____ Date:_____**

**Radiation Safety Committee Chairman:_____ Date:_____**

**Approved Radiation Program Number:**

**Program Expiration Date:**

**NCI-FREDERICK CANCER RESEARCH AND DEVELOPMENT CENTER**

## RADIOLOGICAL TRAINING AND EXPERIENCE

**(THIS FORM MUST BE TYPED)**

**The following requested information will be used by the FCRDC Radiation Committee to determine whether the named individual will be allowed to use radioactive isotopes under the FCRDC NRC license. Please supply as much detail as possible. Use additional pages, as needed.**

**TO: RADIATION SAFETY OFFICE PROGRAM_____**

**New Applicant:_____**
**First Middle Last Employee No.**

**Birth Date_____ Social Security Number_____**

**A. Present Position:**

**Employer: Government___ SAIC___ ABL___ Other**

**B. Educational Background (include degree(s), major college or university and year degree(s) awarded and where:**

**C. Formal Experience (Formal course - include dates, and if semester, week, etc., where):**

**D. On the Job Training (number of weeks, months, years, etc. - include year) (include radionuclides and activities used) where:**

**RADIOLOGICAL TRAINING AND EXPERIENCE (Cont'd)**

**E. Type of Training**

1. **Principles and practices of radiation protection (<u>where</u> and <u>when</u>):**

2. **Radioactivity measurement standardization and monitoring techniques and instruments:**

3. **Mathematics and calculations basic to the use and measurement of radioactivity:**

4. **Biological effects of radiation:**

**F. Isotope clearances (usage) Requested: (Isotope/activity per experiment)**

**The above accurately reflects my prior radiologic experience. In applying for authorization to use radioisotopes at the NCI-FCRDC, I will abide by all requirements set forth in the Radiologic Safety Manual, and further, understand that I must receive specific training in lab protocols prior to such use.**

**_____ Date _____**
**Applicant Signature**

**I have reviewed the above qualifications and accept responsibility for the applicant's use of radioisotopes as outlined under article C of the NCI-FCRDC Radiation Safety Manual.**

**_____ Date _____**
**Principal Investigator's Signature**

**b. Equipment That Produces Ionizing Radiation for Non-Medical Purposes**

**(1) All operations involving the use of accelerators (Van de Graff generators, cyclotrons, betatrons, etc.), X-ray machines, static elimination devices, and other equipment that produces ionizing radiation will be approved by the Committee**

**prior to their installation and operation. Approval will be given by means of a Radiological Program that shall be submitted to the FCRDC Radiation Safety Committee, through the Radiation Protection Officer, in duplicate and will describe the proposed operation, including the following information:**

**(a) The project wishing to use the machine**

**(b) The full names, social security numbers, and birth dates of the Radiation Area Supervisor, responsible investigator, and all other operational personnel**

**(c) The type of machine to be used, including the operating characteristics (voltage, amperage, filters, targets) as well as the manufacturer, model, and serial number**

**(d) A complete description of the operations to be performed**

**(e) The location, by building and room number, in which the machine is to be installed and a complete floor plan showing adjacent areas, proposed position of the machine, the console, and shielding**

**(f) A complete list of radiation monitoring and other equipment available for the proposed test program**

**(g) The radiation rules and precautions to be used in the proposed test plan**

**(h) The signature of the Supervisor or Principal Investigator in charge of the activity**

**(2) The program will be approved on the basis of the available equipment and facilities, as well as the radiation experience of the operating personnel and the responsible investigator.**

**(3) The requestor shall not begin the described operations until the proposed plan has been approved and returned to him by the FCRDC Radiation Safety Committee.**

**2. PROCUREMENT OF RADIOACTIVE MATERIAL**

**A proposed radiation program must be approved before a request for procurement approval is made.**

**a. The procurement of all radioactive materials and machines capable of producing ionizing radiation will be accomplished only with the prior approval of the Radiation Protection Office and Committee. The materials and equipment mentioned above fall into four general categories with regard to procurement:**

**(1) Materials produced by or under the auspices of the Nuclear Regulatory Commission and requiring a Nuclear Regulatory Commission, Specific License**

**(2) Materials procurable under a Nuclear Regulatory Commission, General License**

**(3) Other radioactive materials subject to agreement State requirements (Maryland is an agreement state.)**

**(4) Apparatus and equipment capable of, or containing materials capable of, producing ionizing radiation. This includes X-ray machines, particle accelerators, certain cathode-ray tubes, electron microscopes, and many other devices.**

**b. The procurement of items in all four categories listed above will be initiated only with prior approval of the program. Information concerning the procedure for the procurement of items in the above categories is available from the Radiation Protection Office.**

**c. The Radiation Protection Office will be notified immediately when a shipment containing radioactive materials arrives on post. Small items will be picked up by the Radiation Protection Office, Building 426, who will accomplish final delivery after a contamination check of contents and preparation of necessary forms. Notify the Radiation Protection Office immediately upon receipt of larger items for clearance prior to delivery.**

## 3. ISOTOPE INVENTORY AND SHIPMENT

**The Radiation Protection Office will request isotope inventories for control purposes and reserves the right to request periodic reports concerning the use of isotopes or equipment. Each Radiation Area Supervisor should keep accurate records of receipt, expenditure, and relocation of radioactive materials for which he is responsible. Transfer of radioactive materials requires prior approval by the Radiation Protection Office. Transfer of any amount of radioactive material to unauthorized areas is prohibited. Shipments of radioactive material from FCRDC to other destinations must be cleared in advance through the Radiation Protection Office to assure conformance with Nuclear Regulatory Commission, Department of Transportation, Postal, and other shipping regulations as well as with Radiation Protection Office inventory requirements.**

## 4. INACTIVATION OR AMENDMENT OF A RADIATION PROGRAM

**a. Inactivation**

**Whenever a radiation program is to be discontinued or a radiation area is to be returned to non-radiological use, the Radiation Protection Office will be notified in writing by the Radiation Area Supervisor. Before any of the above actions can take place, the Radiation Protection Office will check the program to ensure that:**

**(1) The area is free of all radioactive materials and contaminants.**

**(2) All radiation caution signs and labels are removed.**

**(3) All radioactive material that is still in the possession of the user is stored in the radiological holding area or is disposed of properly.**

**(4) Film badge services are discontinued.**

**(5) Other pertinent radiation protection matters have been completed.**

**b. Amendment**

**(1) Any proposed change to an approved radiological program at FCRDC must be submitted in memorandum form to the Radiation Safety Committee through the Radiation Protection Office for approval prior to the initiation of the change.**

**(2) Examples of items requiring amendment approval are:**

**(a) Requests to use isotopes and procedures other than those specified in the original program application**

**(b) Personnel additions and deletions**

**(c) Requests to use other laboratory areas at FCRDC**

## APPENDIX III

## RADIATION WARNING SIGNS

**RADIATION CAUTION SIGNS AND LABELS**

**All radiation caution signs and labels shall be the conventional radiation caution colors (magenta or purple on a bright yellow background) and shall display the radiation caution symbol, the design of which is shown in 10 CFR 20.901 (31 January, 1986).**

**All radiation caution signs for radiation areas shall have the radiation caution symbol and the words:**

**CAUTION**

**RADIATION AREA**

**DOSE RATE AT THIS POINT**

**IS**

**All radiation caution signs for high radiation areas shall have the radiation caution symbol and the words:**

**CAUTION**

**HIGH RADIATION AREA**

**DOSE RATE AT THIS POINT**

**IS**

**All radiation caution signs for air-borne radiation areas shall have the radiation caution symbol and the words:**

**CAUTION**

**AIR-BORNE RADIOACTIVITY AREA**

**DO NOT REMAIN IN THIS AREA**

**In all radioactive materials areas where the radiation levels are below the requirements listed for a radiation area, a radiation caution sign will be used that shall have the radiation caution symbol and the words:**

**CAUTION**

**RADIOACTIVE MATERIALS**

**In addition to the preceding requirements, radiation caution signs may display further warnings, such as "Keep Out"; "Danger, Radioactive Contamination"; etc., whenever such warnings are appropriate. In all cases, the Radiation Protection Office will be responsible for the posting of all radiation areas.**